

**Installation
Guide**

hp StorageWorks FCA2684/FCA2684DC PCI-X Host Bus Adapters for OpenVMS and Tru64 UNIX

First Edition (May 2004)

Part Number: AA-RV2JA-TE

This guide describes how to install, configure, and troubleshoot the HP StorageWorks FCA2684/FCA2684DC PCI-X host bus adapters for Tru64 UNIX and OpenVMS operating systems.



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About this Guide

This installation guide provides information to help you:

- Install, configure, and troubleshoot the FCA2684/FCA2684DC PCI-X host bus adapters (HBA) for Tru64 UNIX and OpenVMS operating systems.
- Contact technical support for additional assistance.

“About this Guide” topics include:

- [Overview](#), page 6
- [Conventions](#), page 7
- [Getting help](#), page 10

Overview

This section covers the following topics:

- [Intended audience](#)
- [Related documentation](#)

Intended audience

This book is intended for use by administrators who are experienced with the following:

- Tru64 UNIX and OpenVMS operating systems
- Host bus adapters

Related documentation

In addition to this guide, HP provides the *HP StorageWorks FCA2684/FCA2684DC PCI-X Host Bus Adapter for OpenVMS and Tru64 UNIX Release Notes*.

Conventions

Conventions consist of the following:

- Document conventions
- Text symbols
- Equipment symbols

Document conventions

This document follows the conventions in [Table 1](#).

Table 1: Document conventions

Convention	Element
Blue text: Figure 1	Cross-reference links
Bold	Menu items, buttons, and key, tab, and box names
<i>Italics</i>	Text emphasis and document titles in body text
Monospace font	User input, commands, code, file and directory names, and system responses (output and messages)
Monospace, italic font	Command-line and code variables
Blue underlined sans serif font text (http://www.hp.com)	Web site addresses

Text symbols

The following symbols may be found in the text of this guide. They have the following meanings:



WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or death.



Caution: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or data.

Tip: Text in a tip provides additional help to readers by providing nonessential or optional techniques, procedures, or shortcuts.

Note: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Equipment symbols

The following equipment symbols may be found on hardware for which this guide pertains. They have the following meanings:



Any enclosed surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

WARNING: To reduce the risk of personal injury from electrical shock hazards, do not open this enclosure.



Any RJ-45 receptacle marked with these symbols indicates a network interface connection.

WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.



Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. Contact with this surface could result in injury.

WARNING: To reduce the risk of personal injury from a hot component, allow the surface to cool before touching.



Power supplies or systems marked with these symbols indicate the presence of multiple sources of power.

WARNING: To reduce the risk of personal injury from electrical shock, remove all power cords to completely disconnect power from the power supplies and systems.



Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manually handling material.

Getting help

If you still have a question after reading this guide, contact an HP authorized service provider or access our web site: <http://www.hp.com>.

HP technical support

Telephone numbers for worldwide technical support are listed on the following HP web site: <http://www.hp.com/support/>. From this web site, select the country of origin.

Note: For continuous quality improvement, calls may be recorded or monitored.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

HP storage web site

The HP web site has the latest information on this product, as well as the latest drivers. Access storage at: <http://www.hp.com/country/us/eng/prodserv/storage.html>. From this web site, select the appropriate product or solution.

HP authorized reseller

For the name of your nearest HP authorized reseller:

- In the United States, call 1-800-345-1518
- In Canada, call 1-800-263-5868
- Elsewhere, see the HP web site for locations and telephone numbers: <http://www.hp.com>.

Features



This introduction to the FCA2684/FCA2684DC HBAs includes:

- [Performance specifications](#), page 12
- [Standards](#), page 14
- [Agency approvals](#), page 15

Performance specifications

The FCA2684/FCA2684DC PCI-X host bus adapter offers a highly integrated 2 Gbps Fibre Channel HBA for use in servers based on either PCI or the latest PCI-X expansion bus. The features of this PCI-X based HBA provide the flexibility and broad interoperability needed for complex, highly scalable SANs.

The FCA2684/FCA2684DC also features sophisticated hardware that provides superior performance in SANs and provides best in class server CPU off load. This exclusive hardware delivers low latency and high throughput in switched fabric, arbitrated loop, and clustered environments. Support for fiber optic cabling is provided through an embedded small form factor (LC) optical interface.

The FCA2684 is a single channel HBA in a low-profile PCI compliant card format. The FCA2684DC is a dual channel HBA. These HBAs are both ANSI Fibre Channel and PCI Local Bus Compliant and support:

- Full duplex 2 Gbps Fibre Channel delivering up to 400MB/s
- Superior transaction processing performance
- Automatic speed negotiation
- Automatic topology detection
- Full fabric support using F_Port and FL_port connections
- Onboard hardware context cache for superior fabric performance
- Support for use of multiple concurrent protocols (SCSI and IP for OpenVMS only)
- Full support for both FC service class 2 and 3
- Support for FC-Tape (FCP-2) devices
- 66/100/133 MHz PCI-X 1.0a and PCI 2.3 compatibility
- End-to-end parity protection for high data integrity
- 3.3V signaling, 5V tolerant
- Optical small form factor (LC) interface

Figure 1 shows the FCA2684 HBA.



Figure 1: FCA2684 host bus adapter

Table 2 describes the HBA components.

Table 2: Host bus adapter diagram description

Figure Legend	Description
❶	Power On Self Test (POST) LED Indicators See Table 6 on page 32 for detailed descriptions.
❷	Fibre Channel (LC) connector
❸	Jumper settings - See Table 3 on page 18 for detailed descriptions

Standards

The HBA conforms to the following standards:

- ANSI Fibre Channel FC-PH, Revision 4.3
- ANSI Fibre Channel FC-AL, Revision 4.5
- ANSI Fibre Channel FC-FS
- ANSI Fibre Channel FC-PI
- ANSI Fibre Channel FC-PLDA
- ANSI Fibre Channel FC-MI
- ANSI Fibre Channel FC-FLA
- Fibre Channel Class 2, 3
- PCI-X 1.0a
- PCI local bus revision 2.2
- PHP hot plug - hot swap

Agency approvals

The HBA has the following agency approvals:

- CFR Title 21, Laser AEL Class 1, FDA/CDRH
- UL recognized to UL1950
- CUR recognized to CSA22.2, No.950
- EN68025-1 (1994) + Amendment 11
- EN68025-2 (1994)
- TUV certified to EN60950
- FCC Rules, CFR Title 47, Part 15, Subpart B, Class A
- Industry Canada, ICES-003, Class A
- EN55022 (1998)/CISPR22 (1997) Class A
- EN55024 (1998)
- CE-Marking Directive 93/68/EEC (CE Mark)
- EMC Directive 89/336/EEC (as amended by 92/31/EEC)
- Australian EMC Framework (C-Tick Mark)
- AS/NZS 3548:1995, Class A
- VCCI, Class A

Installation

2

This chapter provides step-by-step instructions for installing the FCA2684/FCA2684DC host bus adapter (HBA) including:

- [Prerequisites](#), page 18
- [Recording reference numbers](#), page 19
- [Installing the HBA into a computer](#), page 20
- [Verifying the installation](#), page 22
- [Configuration guidelines](#), page 23

This chapter also provides information on installation guidelines and supported configurations for the operating systems.



Caution: The HBA contains static-sensitive components. Comply with Electrostatic Discharge (ESD) procedures.

Prerequisites

- PCI 32/64-bit data and 33/66 MHz clock frequency
- PCI-X 64-bit data and 66/100/133 MHz clock frequency
- 32/64-bit addressing, 3.3V signaling (5V tolerant)
- 3.3V and 5V PCI power required for operation
- Media and connectors
- Multimode fiber optic cable with LC connector, used with short-wave lasers.

Set jumpers

[Table 3](#) lists the FCA2684/FCA2684DC jumper settings. The HBA has two jumper blocks (JX1, JX2) that control the host adapter's device ID. The default device ID is FA00. See [Figure 1](#) on page 13 for detailed descriptions.

Table 3: Jumper settings

Device ID	Jumper Setting
FA00	JX1:1-2, JX2:2-3
1AE5	JX1:2-3, JX2:2-3
FA01	JX1:2-3, JX2:1-2

Recording reference numbers

Each HBA ships with a unique address identifier called the IEEE address. The Fibre Channel industry standards use a World Wide Name (WWN) derived from the IEEE address. You need this number for Fibre Channel connectivity as well as for configuring your system.

The serial number is used when you communicate with HP about your HBA.

The WWN address and serial number are clearly marked on the HBA. Record the addresses on the lines below for future reference.

IEEE address: _____

Serial number: _____

Installing the HBA into a computer

Following is the procedure for installing the HBA into a computer.



WARNING: Be sure to observe the ESD precautions for this procedure as described in “[Electrostatic Discharge](#)” on page 41.

1. Make sure the computer is powered off.
2. Remove the screws on the computer cover, and then remove the cover.
3. Wearing a static wrist strap, remove the blank panel from an empty 32- or 64-bit PCI or PCI-X bus slot.
Compare the removed panel to the bracket on the host bus adapter. Follow steps 4–7 to change the bracket if they are different sizes.
4. Remove the mounting bracket screws from the top of the host bus adapter.
5. Remove the bracket and store it for future use.
6. Using the bracket on the HBA, align the new mounting bracket tabs with the holes in the HBA.

Note: Be careful not to push the bracket past the transceiver housing's grounding tabs.

7. Replace the screws that attach the HBA to the bracket.
8. Insert the HBA into the empty PCI or PCI-X bus slot; press firmly until it is seated securely.
9. Secure the HBA mounting bracket to the computer panel with the panel screws.
10. Replace the computer cover and secure it using the previously removed screws.
11. Attach media:
 - a. Connect the fiber optic cable to the LC connector on the HBA.
 - b. Connect the other end of the cable to the Fibre Channel device.

Note: These HBAs do not allow normal data transmission on an optical link unless they are connected to a similar or compatible laser product. That is, both products are multimode to multimode.

Verifying the installation

To verify that the HBA is properly installed and is operating:

1. Turn on the computer.
2. At power up, observe the Power On Self Test (POST) LED indicators on the HBA. The position of the POST LED indicators is defined in [Figure 1](#) on page 13 and [Table 2](#) on page 13. The green LED indicates power functions, and the amber LED signifies port activity. The amber LED blinks at all times during normal operation. [Table 4](#) lists indications you may see after installation.

Table 4: Normal POST LED indicators

Amber LED (L1)	Green LED (L2)	State
Flashing (irregular)	Off	POST processing in progress
Slow blink (1 Hz)	On	Normal—1 Gb link rate
Fast blink (4 Hz)	On	Normal—2 Gb link rate
Off	Blink (1 Hz)	Normal—link down or not yet started

Configuration guidelines

The driver is provided as part of Tru64 or Open VMS, or as part of their associated patch kits. For information on supported configurations specific to your operating system and topology, refer to:

- *FCA2684/FCA2684DC PCI-X Host Bus Adapters for Open VMS and Tru64 Release Notes*
- *HP StorageWorks SAN Design Guide* available at <http://h18006.www1.hp.com/storage/saninfrastructure.html>.

Installing and Configuring Device Drivers

3

This chapter describes how to install and configure the HBA device drivers. It includes the following sections:

- [Tru64 UNIX driver and Alpha Console support](#), page 26
- [Using the Alpha Console wwidmgr -show adapter and -set adapter commands](#), page 27
- [OpenVMS driver and console support](#), page 30

You should be familiar with the operating system under which the HBA operates. You must also have access to standard operating system documentation.

The HBA software kit contains the latest version of the HBA files at the time of shipment. You can obtain periodic updates from the HP web site:

<http://h18006.www1.hp.com/storage/saninfrastructure.html>.

Note: HP recommends that you back up all operating system files before you install and configure the HBA device drivers.

Tru64 UNIX driver and Alpha Console support

This HBA driver is built into the Tru64 UNIX operating system and is supported by the Alpha Console. For the supported versions of Tru64 UNIX and the Alpha Console, consult the *FCA2684/FCA2684DC PCI-X Host Bus Adapters for OpenVMS and Tru64 Release Notes*.

Release notes are updated periodically and can be obtained from the HP web site:

<http://h18006.www1.hp.com/storage/saninfrastructure.html>.

See the documentation specific to your platform for detailed information on installing the appropriate operating system and Alpha Console.

Note: You must initialize the Console before and after issuing `wwidmgr` commands. Otherwise, the server will not reboot.

Using the Alpha Console `wwidmgr -show adapter` and `-set adapter` commands

With Alpha Console v6.7 and higher, you can set the HBA to run in either Fiber Channel Arbitrated Loop (FC-AL) mode or in Fabric (Switch) mode. By default, the console assumes a fabric topology. When configuring the HBA, keep the following considerations in mind:

- The `wwidmgr -set adapter` command stores the selected topology into the NVRAM storage on the HBA. If you move the HBA from one Alpha Server to another, this setting stays with the HBA. Alpha Console v6.7 and higher is required to support the FCA2684/FCA2684DC.
- An FC-AL loop setting is a valid setting in Alpha Console v6.7, however, that setting prompts the console driver not to run.



Caution: If you connect an HBA to a switch using an FC-AL loop setting, the results are unpredictable. The same is true for setting an HBA in fabric mode.

Access the `wwidmgr` manual as follows for detailed information on the `wwidmgr -show adapter` and `-set adapter` commands:

1. Browse to <ftp://ftp.digital.com/pub/DEC/Alpha/firmware>.

Note: Enter the URL exactly as shown as it is case-sensitive.

2. Select the directory for the current console firmware release.
3. Select the `doc` directory.
4. Select `wwidmgr.pdf`.

The following section describes how to use these commands to view and set the HBA driver configuration.

Using the `wwidmgr -show adapter` command

Use the `wwidmgr -show adapter` command to view HBA configuration.

The following example shows a display from `wwidmgr -show adapter` for a system with two HBAs:

```
LP00>>>wwidmgr -show adapter
```

Item	adapter	WWN	Cur. Topo	Next Topo
[0]	kgpsaa0.0.0.4.6	1000-0000-c921-05ab	fabric	fabric
[1]	kgpsab0.0.0.8.6	1000-0000-c921-0ce0	fabric	fabric
[9999] All of the above.				

Table 5 describes the elements of the following display line in detail:

```
[0]kgpsaa0.0.0.4.6 1000-0000-c921-05ab fabric fabric
```

Table 5: `wwidmgr -show adapter` display elements

Item	Description	Explanation
[0]	Item Number	A parameter to the <code>-item</code> qualifier in the <code>-set adapter</code> command. You can select which HBA to configure by its item number. An item number of 9999 selects all HBAs.
kgpsaa0.0.0.4.6	Adapter Mnemonic	Error messages and displays use this identifier.
1000-0000-c921-05ab	The HBA's WWN	This value identifies the HBA to other nodes on the fibre channel link.
fabric	Current Topology	The HBA's operating mode for the current session; either fabric or loop . This mode is not affected during a <code>wwidmgr</code> session.
fabric	Next Topology	The topology setting for the HBA's NVRAM. Unavail indicates that the NVRAM is not formatted. Fabric or loop indicates the HBA's configuration the next time the system is initialized.

Using the `wwidmgr -set adapter` command

Use the `wwidmgr -set adapter` command to format the HBA NVRAM and to configure an HBA to run on a loop or a fabric.

The command format is:

```
wwidmgr -set adapter -item<itemno> -topo<fabric | loop>
```

The `itemno` bracketed value is the value from the `-show adapter` command. You can change all HBAs from fabric to loop by specifying an `itemno` value of 9999.

In the following example, `init` is placed at the end to emphasize that the setting in the running HBA is not changed until the next initialization.

```
LP00>>>wwidmgr -show ada
```

Item	adapter	WWN	Cur. Topo	Next Topo
[0]	kgpsaa0.0.0.8.1	1000-0000-c920-05ab	fabric	fabric
[1]	kgpsab0.0.0.10.1	1000-0000-c921-0ce0	fabric	fabric
[9999] All of the above				

```
LP00>>>wwidmgr -set adapter -item 9999 -topo loop
```

```
LP00>>>wwidmgr -show ada
```

Item	adapter	WWN	Cur. Topo	Next Topo
[0]	kgpsaa0.0.0.8.1	1000-0000-c920-05ab	fabric	loop
[1]	kgpsab0.0.0.10.1	1000-0000-c921-0ce0	fabric	loop
[9999] All of the above.				

```
LP00>>>init
```

OpenVMS driver and console support

The FCA2684/FCA2684DC driver for OpenVMS is not built into the following base versions of the operating system and requires a FIBRE_SCSI TIMA kit:

- 7.2-2
- 7.3-1
- 7.3-2

Refer to the documentation specific to your platform for detailed information about installing the appropriate operating system and Alpha Console.

For the supported versions of OpenVMS, TIMA Kit, and Console, refer to the *FCA2684/FCA2684DC PCI-X Host Bus Adapters for Open VMS and Tru64 Release Notes*. Release notes are updated periodically and can be obtained from the HP web site:

<http://h18006.www1.hp.com/storage/saninfrastructure.html>.

Troubleshooting

4

The Power-On Self Test (POST) is a troubleshooting utility that you can use for the FCA2684/FCA2684DC HBAs. This chapter explains the use of this utility in the event of an HBA problem.

POST LED states

[Table 6](#) lists the HBA LED states with descriptions of each state. The location of the POST LED indicators is defined in [Figure 1](#) on page 13 and [Table 2](#) on page 13.

If the LEDs indicate a failure during POST:

1. Make sure that the HBA is seated firmly in the PCI slot.
2. Verify that the fibre cable connection to the HBA is secure.

Table 6: POST LED states

Amber LED (L1)	Green LED (L2)	Description
Off	Off	Wake-up failure (dead board)
On	Off	POST failure (dead board)
Slow blink (1 Hz)	Off	Wake-up failure (dead board)
Fast blink (4 Hz)	Off	Failure in POST (dead board)
Flashing (irregular)	Off	POST processing in progress
Off	On	Failure while functioning
On	On	Failure while functioning
Slow blink (1 Hz)	On	Normal—1 Gb link rate
Fast blink (4 Hz)	On	Normal—2 Gb link rate
Off	Blink (1 Hz)	Normal—link down or not yet started

Regulatory Compliance Notices



This appendix covers the following topics:

- [Federal Communications Commission Notice](#), page 34
- [Canadian notice \(Avis Canadien\)](#), page 36
- [European Union notice](#), page 37
- [Japanese notice](#), page 38
- [Laser safety](#), page 40

Federal Communications Commission Notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (for example, personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

The rating label on the device shows the classification (A or B) of the equipment. Class B devices have an FCC logo or FCC ID on the label. Class A devices do not have an FCC logo or ID on the label. After the class of the device is determined, refer to the corresponding statement in the sections below.

Class A equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

Declaration of Conformity for products marked with FCC logo—United States only

This device has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference, in which case users will be required to correct the interference at their own expense. The end user of this product should be aware that any changes or modifications made to this equipment without the approval of Hewlett-Packard could result in the product not meeting the Class A limits, in which case the FCC could void the user's authority to operate the equipment.

Network and serial cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

IEC EMC statement (worldwide)

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

Spécification ATI Classe A (France)

DECLARATION D'INSTALLATION ET DE MISE EN EXPLOITATION d'un matériel de traitement de l'information (ATI), classé A en fonction des niveaux de perturbations radioélectriques émis, définis dans la norme européenne EN 55022 concernant la Compatibilité Electromagnétique.

Canadian notice (Avis Canadien)

Class A equipment

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

European Union notice

Products with the CE Marking comply with both the EMC Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Norms (the equivalent international standards are in parenthesis):

- EN55022 1998 (CISPR 22) – Electromagnetic Interference
- EN55024 1998 (IEC61000 – 4-2, IEC61000-4-3, IEC61000-4-4, IEC61000-4-5, IEC61000 – 4-6, IEC61000-4-8, IEC61000-4-11) – Electromagnetic Immunity
- EN60950 (IEC60950)-Product Safety
- Power Quality: (IEC61000-3-2) – Harmonics and (IEC61000-3-3) – Voltage Fluctuations and Flicker
- Also approved under UL 1950, 3rd Edition/CSA C22.2 No. 950-95, Safety of Information Technology Equipment

Japanese notice

ご使用になっている装置にVCCIマークが付いていましたら、次の説明文をお読み下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスB情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。

VCCIマークが付いていない場合には、次の点にご注意下さい。

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Harmonics conformance (Japan)

高調波ガイドライン適合品

Laser safety



WARNING: To reduce the risk of exposure to hazardous radiation:

- Do not try to open the laser device enclosure. There are no user-serviceable components inside.
- Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.
- Allow only HP authorized service technicians to repair the laser device.

Certification and classification information

This product contains a laser internal to the Optical Link Module (OLM) for connection to the Fiber communications port.

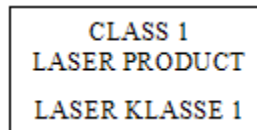
In the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation 21 CFR, Subchapter J. The certification is indicated by a label on the plastic OLM housing.

Outside the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in IEC 825-1:1993 and EN 60825-1:1994, including Amendment 11:1996.

The OLM includes the following certifications:

- UL Recognized Component (USA)
- CSA Certified Component (Canada)
- TUV Certified Component (European Union)
- CB Certificate (Worldwide)

The following figure shows the Class 1 information label that appears on the metal cover of the OLM housing.



Electrostatic Discharge



B

To prevent damaging the system, be aware of the precautions you need to follow when setting up the system or handling parts. A discharge of static electricity from a finger or other conductor may damage system boards or other static-sensitive devices. This type of damage may reduce the life expectancy of the device.

To prevent electrostatic damage, observe the following precautions:

- Avoid hand contact by transporting and storing products in static-safe containers.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free workstations.
- Place parts on a grounded surface before removing them from their containers.
- Avoid touching pins, leads, or circuitry.
- Always make sure you are properly grounded when touching a static-sensitive component or assembly.

Grounding methods

There are several methods for grounding. Use one or more of the following methods when handling or installing electrostatic-sensitive parts:

- Use a wrist strap connected by a ground cord to a grounded workstation or computer chassis. Wrist straps are flexible straps with a minimum of 1 megohm \pm 10 percent resistance in the ground cords. To provide proper grounding, wear the strap snug against the skin.
- Use heel straps, toe straps, or boot straps at standing workstations. Wear the straps on both feet when standing on conductive floors or dissipating floor mats.
- Use conductive field service tools.
- Use a portable field service kit with a folding static-dissipating work mat.

If you do not have any of the suggested equipment for proper grounding, have a HP authorized reseller install the part.

Note: For more information on static electricity, or for assistance with product installation, contact your HP authorized reseller.

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